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ABSTRACT

This research reports on a constructivist approach that was used in a unit of work with a final year high school biology class. The aim of the intervention was to promote students' awareness and communication of the biological, social, and ethnical issues associated with cancer. Students were encouraged to use an inquiry approach. They were also provided with opportunities to engage in open and critical discourses and develop independent learning skills through metacognitive behaviors. The students', teachers', and the researcher's perspectives on aspects of the unit of work are used to evaluate the approaches used. Pre- and post-questionnaires, thinking journals, classroom observations, and interviews provide evidence of how aspects of the unit influenced students' thinking. The majority of students reported that the unit of work modified and broadened their ideas about bioethical issues linked with cancer. The results indicate what was important for teaching social and ethical issues in this biotechnological context. (Contains 26 references.) (Author/YDS)

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The significance of an approach to the teaching of societal issues related to biotechnology

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Abstract

This research reports on constructivist approach that was used in a unit of work with a final year high school biology class. The aim of the intervention was to promote students awareness and communication of the biological, social and ethical issues associated with cancer. Students were encouraged to use an inquiry approach. They were also provided with opportunities to engage in open and critical discourses and develop independent learning skills through metacognitive behaviours. The students', teachers' and the researcher's perspectives on aspects of the unit of work are used to evaluate the approaches used. Pre and post questionnaires, thinking journals, classroom observations and interviews provide evidence of how aspects of the unit influenced students' thinking. The majority of students reported that the unit of work modified and broadened their ideas and thinking about bioethical issues linked with cancer. The results indicate what was important for teaching social and ethical issues in this biotechnological context.

Introduction

Worldwide there is a concern about how the use and application of biotechnology will affect society. Recognition of the extraordinary transformation powers of biotechnological innovation, not only over the means of production of food and advances in medicine, but also over lifestyles and human values, has posed ethical, moral and social questions at both an individual and societal level. In countries such as New Zealand, where there is strong economic reliance on biotechnologies, science curricula now include biotechnology. The implications for teaching ethics and social responsibilities associated with these issues have been discussed elsewhere (Conner, *in press*).

The *New Zealand Curriculum Framework* states in its pages on attitudes and values that the school curriculum "will reinforce the commonly held values of individual and collective responsibility which underpin New Zealand's democratic society" (Ministry of Education, 1993b, p21). Also stated in the New Zealand document *Education for the 21st Century* is that "It is important that every New Zealander develops a clear understanding of commonly held values of individual and collective responsibility and accountability. Furthermore, they should have a clear understanding of their own values and beliefs, while developing a respect and sensitivity to the rights of individuals, families, and groups to hold values and attitudes which are different from their own" (Ministry of Education, 1993a, p 23).

Biology in the New Zealand Curriculum requires year 13 Biology students (final year High School) to *investigate contemporary biological issues and make informed judgements on any social, ethical, or environmental implications* (Achievement Objective 8.3(a), Ministry of Education (1994)). Students are required to write an essay on such an issue of about 500 words in the end of year University Bursary Examination which is worth 20% of the exam mark. It is therefore very important that students develop skills

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in independent research and essay writing as well as their thinking about the biological, social and ethical issues that are linked with their topic.

Although social and ethical issues are being addressed for some areas of biotechnology in science and biology courses in New Zealand, the depth of treatment is questionable and the approaches necessary for implementation still need to be evaluated (Conner, *in press*). While there is considerable discussion of various models and strategies for effective teaching of factual material and concepts, and for teaching discrete skills and recognised processes like the "scientific" inquiry process, much less is heard about how to teach effectively in areas that require sensitivities to moral, ethical and social dimensions which are linked with the use of technologies.

Issues associated with cancer provide a rich source of dilemmas for students to consider. In particular, many of these issues are associated with the biological knowledge and medical technology relating to cancer screening and treatment. These issues include lifestyle choices, who to treat and how to treat cancer patients, the costs involved and the resultant preventative treatments (including surgery), diagnostic techniques, genetic screening, euthanasia and the personal, family and social implications of all of these.

The research reported here is part of the my doctoral study which was undertaken to describe and evaluate an approach to teaching and learning about social and ethical issues in a senior biology course in New Zealand. It was not expected that students should be able to resolve bioethical issues, which has been the aim of some previous approaches (Barman & Hendrix, 1983; Dawson & Taylor, 1999). Instead, the aim of the approach used was to promote students' awareness and communication of social and ethical issues more directly.

Unfortunately some students in senior classes in New Zealand schools still expect to be 'spoon-fed', to be told the facts and where and how. This has also been a strong element of the culture in science teaching in the past, linked to teachers imparting facts and students perceiving that they do not need to question or think for themselves. This can be linked to a more traditional image of science and science teaching (Carr et al., 1994). It was considered that students needed help to use a more self-directed learning approach. This involved helping students to identify their own learning skills with regard to researching and essay writing so that they could enhance their learning through more conscious control.

The unit on cancer is usually designed to encourage students to research using an inquiry approach and write their own essays. Students participating in this study were reasonably familiar with this general approach. Differences in the approach adopted for this study were a more explicit use of checklist and planning guidelines for students to conduct their research and essay writing, as well as more emphasis on peer discussion, peer checking and journal writing.

Requirements of the approach

In learning about controversial issues associated with cancer, students need to shift from 'dualistic reasoning' where they believe there is always a right and wrong answer, to where the partial validity of contrasting interpretations of reality is considered (Rudduck, 1986). The nature of controversial issues is that there will be more than one defensible position. Therefore the teacher needs to be conscious of the ideas of 'objectivity, balance, and neutrality' often employed in discussing controversial issues and not act as an authority. This may cause a dilemma for the teacher, who will be

expected by students to give his/her own opinion (Solomon, 1991). There needs to be a 'spirit of inquiry' rather than an approach which aims to convince students of "the truth". This can be implemented through teachers modelling "rational authority" where they give examples backed up with reasons for knowledge claims (Geddis, 1991) and through critical questioning (Lipman, 1987) which may lead to the acceptance of multiple perspectives. The teacher also needs to create and maintain an environment where the relationships between the teacher and students and among students are open and egalitarian. Acceptance of multiple perspectives is essential.

In student-centred approaches to learning - constructivist, generative and inquiry approaches - the teacher is required to act as a facilitator rather than act as an authority. This is so that students value their own ideas and use them to scaffold their knowledge and awareness. Firstly students need to clarify their own knowledge and ideas. They can then increase their awareness, build upon, integrate and extend their ideas through social interaction with others. Small group and whole class discussions have been used to develop "negotiated meaning" (Cohen, 1994).This may be a new approach for more traditional science teachers who are more accustomed to a transmissive way of teaching. "Transmissive teaching avoids discussion (since learners lack knowledge worthy of consideration) and interactions which might reveal teachers' uncertain knowledge and so alter the power relationships in their classrooms" (Carr et al., 1994).

Facilitation requires offering students opportunities to make decisions and solve problems on their own, without being told what to do at all times. Student goal setting (deciding how to go about learning procedures), monitoring and evaluating learning all promote an independent learning approach (Winne, 1996). This can be a very empowering concept. If we can provide students with strategies designed to help them process information effectively and to be more reflective about and in control of their thinking and learning processes, they may be more motivated and believe that they have the abilities to succeed (Paris & Winograd, 1990). Motivation to learn should not be underestimated as an important factor that determines learning outcomes.

Critical questioning is also required for metacognitive approaches and self-directed learning to occur (Garrison, 1992). Metacognitive approaches require learners to actively engage as active participants in their learning. They need to focus on critical elements of their learning tasks by monitoring and controlling their progress (Gunstone, 1994). The teacher may need to actively encourage and model metacognitive processes and provide a social setting and a relevant context that enables joint negotiation for understanding. An environment in the classroom that supports autonomy, relatedness and competence is more likely to promote self- regulated learning (Ryan & Stiller, 1991).

What was the approach?

A constructivist approach which incorporated inquiry processes and ways to promote metacognition was used. The four and a half week unit of work was planned by the teacher and researcher together. Identifying and acknowledging prior knowledge was important for identifying content, cognitive and affective aspects of learning. Activities which tapped into the biological, social and ethical prior knowledge of students most directly were a pre-unit questionnaire and a brainstorming exercise in which group ideas were clustered according to students' own categories. Other activities required them to apply their prior knowledge, rather than merely identify it. These included a continuum activity where students had to rank cancer types according to their preventability and a treatment choice activity where small groups were given a scenario about lung cancer and had to discuss and give reasons for their choices. These activity types are often used for values clarification and values

analysis. The latter two activities were the beginning of the social interactions which allowed students' opinions to be aired.

The inquiry process required the students to identify what they wanted to know or needed to find out about cancer. The analysis of the issues required them to evaluate their own feelings and beliefs related to dilemmas. This reflective aspect of the context provided a vehicle to incorporate metacognitive approaches to learning.

In this unit of work, students were encouraged to choose subject material, follow enquiries relative to their own interests and decide how they should go about their own learning. The teacher acted as a facilitator by encouraging students to plan, monitor and evaluate their learning. Planning and monitoring was also encouraged through a written guideline. This emphasised the skills needed for researching, developing questions and writing essays. It also outlined that students should think critically and independently. The students set their own agendas for planning individual research, choosing the two types of cancer they wanted to investigate and deriving the key words and key questions that would drive their work.

They were also given notebooks with prompter statements on bookmarks, to prompt planning, monitoring and evaluation. The statements included:
Something I Learned Today...
What does what I've found out today mean?
It seems important to note .....
I want to...
A question I have is....
I'm lost with....
I disagree with..... because.....
What I need to do now is.....
I can't decide if.....
I'm stuck on.....
I wonder...
What I need to do now is...
I'm wondering why.....
One point of view is....
How...

This approach emphasises the importance of students working collaboratively to discuss issues democratically and non-judgementally. For the social and ethical issues associated with cancer to be handled openly in the classroom, the approach needed to be sensitive. In this study, 11 out of 16 students had a relative or friend who had been affected by some form of cancer. Many students also found the context personally relevant because it made them reflect on lifestyle choices, particularly attitudes to exposure to the sun and smoking. The 'respect for one another' approach was taken seriously by these 17-18 year olds. No significant issues of personal disclosure or discomfort arose. It was therefore essential that the teacher maintained an open and accepting classroom climate.

Spontaneous discussions were prompted via teacher and student questioning. Other small group discussions were on the issues of cancer treatment, genetic screening, euthanasia and human rights. Three videos were shown at different stages of the unit and discussed afterwards. They were "Cancer: Beating the odds" - 4 case studies of New Zealanders with cancer, "Cancer: the facts" - Royal Prince Albert Hospital and "Genetics: a popular guide to the principles of human heredity" - Westmead Neurological Society, Australia. The first video prompted the most discussion due to it's personal nature. All of the discussions

provided forums for students to voice their opinions and hear the opinions of others, thus allowing students to enter a community of discourse where evidence and examples could be discussed.

There were three more teacher-instructed lessons on the nature of cancer, the aetiology of cancer and the meanings of key words related to cancer such as metastasis, oncogene, malignant, carcinogen etc.

Completed draft essays were checked by peers to allow the sharing of ideas about what could be written and how it could be organised. It was hoped that peer checking would prompt reflection on the content and structure of what an essay should be like. It was also hoped that by reading others' essays, students would be exposed to a range of viewpoints about social and ethical issues.

Research design and analysis

This investigation stemmed from a need to promote students' awareness of and communication about the social and ethical issues surrounding cancer more directly. The part of the investigation that is reported here addresses the research question:

How did the unit of work influence students' thinking about the social and ethical issues linked with cancer?

The students knew me, since I had been a teacher at the school chosen for investigation. I had also taught 13 of the 16 students who were willing to take part in the study in previous years. Because of this former relationship, I was not viewed as being an outsider. Although the usual class teacher directed the programme of work, I took on the role of participant observer (Gold, 1958) by answering questions from both the teacher and the students, and prompting students during class work sessions while making observations. The research methodology employed for this part of the study was based on an interpretive case study approach (Merriam, 1988). Utilising Guba and Lincoln's (1989) credibility criterion for judging the quality of the research, the extent to which the students' and teachers' accounts during the post unit interviews honestly portrayed their experiences was gauged through classroom observations of approximately three quarters of the lessons. I took detailed field notes of the information provided and observations made. I also discussed issues with the teacher frequently, as was natural from our previous relationship as colleagues and co-teachers of similar classes in the past. The responses to the same pre and post questionnaires and entries in thinking journals were used as additional data sources to view students' thinking and learning. These data sources triangulate the validity of the claims.

Data to assess the learning and thinking were gathered throughout the unit and were collected in a number of ways. The questionnaires were used to assess prior knowledge and post unit recollection the biological, social and ethical issues and implications associated with cancer. Pre and post questionnaire responses were categorised according to the students answers for each question. These categories were cross-checked by a colleague to verify that they included all answer types and were valid categories. I collected students' thinking journals at the end of most lessons and wrote comments or asked or answered questions. The idea of giving students feedback in this way was to encourage and promote greater usage of the journals and indicate their importance. I retained the journals at the end of the unit.

At the end of the unit the teacher and 16 students were interviewed to survey their views on what had been gained from the unit and what they thought about the approach to the unit. A

summary list of activities in the unit was used to stimulate recall. The interviews were semi-structured but open in that an integral part of these interviews was the elaboration of responses prompted by probing questions. The probing was used to help determine the underlying reasoning used by subjects. The interviews were transcribed.

Students' and the teacher's comments were grouped according to specific activities and general comments about the approach. Sample comments exemplify the range of responses. Contextual clues for these comments are given in italics. It should be noted that not all students commented on every activity.

Students' thinking about social and ethical issues linked with cancer.

Students were required to demonstrate their thinking about the social and ethical issues linked with cancer throughout the unit of work. The data below is an analysis of the questionnaire questions which related to social and ethical issues and general comments about the unit from post unit interviews (iv). These were used to determine changes in students' perceptions about social and ethical issues, and how the activities had contributed to their understandings.

Pre and post questionnaire responses for question 4. W*hat are the '**social implications'** of the topic you have chosen for your investigation*? are given in Table 1. This shows the wide range of answers given. Due to class absences on both days when the questionnaires were answered, only 10 students responded to both questionnaires. The names of students who only responded to one questionnaire are given in italics.

Table 1. Pre and post unit categorisation of responses to '**social implications**'.

Answers	**Pre-unit**	**Post-unit**
no answer or answer not linked to social implications of cancer	Ann Awar *Daniel* Kay Liz Sally	Awar *Samantha*
Personal effects: depression, stress, coping, side effects of treatments	Charlie Lois Mitchel Niome Tulane	Charlie Kay Lois Mitchel Sally *Vincy*
not able to do what you want	Lois	Lois
prevention or treatment?	*Marianne*	Charlie Niome Sally
social responsibility	Charlie Lois *Mary* Mitchel Niome Sally Terri	Charlie Liz Lois Niome *Vincy*

	Tulane	
family responsibility	Charlie Sally	Ann Charlie Lois Mitchel *Vincy*
cost	*Marianne*	Ann Charlie Kay Lois Mitchel Sally
passing laws to limit behaviour eg. no smoking		Liz Niome Terri *Vincy*

There was a distinct shift in some student responses. Even though less students completed the post unit questionnaire, there were increases in responses for 5 of the 7 categories after the unit.

A tally of the number of categories chosen by each of the 10 students who answered both questionnaires was made in order to establish whether their thinking about social issues linked with cancer had broadened as a result of the unit (Table 2). Several students mentioned several issues within the same category. Where this occurred, it was only recorded once.

Table 2. Tally of number of answer categories for question 4 for each student.

Student	**pre-unit**	**post-unit**
Ann	1	2
Awar	0	0
Charlie	3	5
Kay	1	2
Lois	3	5
Liz	1	2
Mitchel	2	3
Niome	2	3
Sally	3	3
Terri	1	1

The number of categories relating to social issues increased from the pre to the post questionnaire for 7 out of 10 students.

A similar tally was undertaken for question 6 of the questionnaire, *What do you think people who are responsible for making decisions about treatment for diseases base their ethical reasons or decisions on?* The results of this are presented in Table 3.

Table 3. Tally of the number of answer categories for Question 6 for each student.

Student	**pre-unit**	**post-unit**

Ann	1	4
Awar	1	1
Charlie	1	3
Kay	2	3
Lois	4	5
Liz	2	3
Mitchel	2	3
Niome	3	6
Sally	2	8
Terri	1	1

The number of category responses in relation to this question increased for 8 out of 10 students. After the unit, they were able to state more factors that need to be considered for making decisions.

Further evidence that students broadened their ideas about the social and ethical issues is provided from their post unit interviews (iv). When students were asked "Do you think this unit of work or doing this essay changed your way of thinking about the ethical ideas at all?" five of the sixteen students said that their ideas had not changed. Other students recognised the impact this unit of work had on broadening their thinking and promoting a more balanced viewpoint.

Ann (iv): Yeah, I know I am more broad about it, I feel I'm more aware of all the contributing factors now, whereas before if I thought it was an old person and they are suffering you should just let them die, but now I think well, they've got family and I can see all the contributing factors now.

Charlie (iv): I think I have a wider understanding of it now, I guess it affects a lot more than just the individual patient, I thought I had a narrow view that it affects the patient and the immediate family, but now I guess it affects the whole of society, which is different. Like society has to decide about cancer and has to make decisions as a whole.

The teacher also commented on how the unit had broadened the students ideas.

Teacher (iv) : They are more aware that there is more than just their one point of view. I think that they have got a better understanding now of it from the patients point of view, from the family's point of view. Whereas before they probably they wouldn't have considered that those other points of view really existed. Wouldn't have thought about it much.

Critical Aspects of the approach

Specific activities were highlighted by students and the teacher as being important for their learning because they were different to what had been done in previous years.

Brainstorming

The topic "cancer" was introduced by allowing groups of 2-4 students to brainstorm ideas on A3 sheets of newsprint. They were encouraged to group their ideas into a graphical organisation according to treatments, types of cancer, causes, effects on the body etc. Student reactions to the brainstorming, as revealed in interviews, were positive.

Ann (iv): At the beginning it was really good to have a brainstorm to see what we already knew and then see what we can pick up from it and it's good because we have still got the brainstorm and I can see what I have already learnt.

Lois (iv): Brainstorming was useful because other people had thought of things that you didn't think of. It made you think. Because it was at the beginning it made you think.

Marianne (iv): Because you have got everybody's else's views on what we were actually talking about and that gave you an idea of how much they knew and how much you knew yourself so you didn't feel dumb or anything.

Tulane (iv): Because everything that you said wasn't right or wasn't wrong, it was just everything that you thought and then develop ideas from certain things.

Researcher: How did it help?

Tulane: Getting my ideas into order, into biological order and knowing how to group things.

These statements suggest that there was a real sense of 'what do we know already?' and that there was a collaborative sharing of ideas between students. The grouping of their ideas also gave them a structured approach to the activity.

Discussions

Central to this approach was the small group and class discussions. Although discussions have been used throughout schooling for these students, the significance here was their use to tap into students' feelings and beliefs in a science context. Students' perceptions of the discussions are given below.

Daniel (iv): You tell what you think *(in small groups)* and then you tell the class and they will come back and say, no I think this. Most people have the same ideas, like in our group which we sort of got corrective surgery to get fixed but it also depends on age and stuff, that's what got through *(from the whole class discussion)*.

Group discussions not only resulted in consensus, but revealed a wider range of views when groups reported back to the class. This allowed students to become more aware of other points of view.

Researcher: So how else did the discussions help?

Daniel (iv): It gives you more knowledge. Stuff that interests you, like that sort of stuff gets into your head easier, like when you talk about it and try and make your point clear, it seems to stick in your head more rather than people telling you or when you are not interested. You're just writing words down *(when the teacher is giving notes)*. You get a different point of view talking to them and try and make a comeback *(giving your own opinion or defending your views)*. You sort of take it in as well.

Mary (iv): I thought it was good. I thought you've got more of a say rather than the other parts of the curriculum. You can put your own opinion in and you knew something about it so it wasn't just what you'd been taught.

These last two comments exemplify the student-directed ownership of the discussions. For some students, this way of learning was not what they thought was appropriate for learning 'the facts' about cancer. However, there was a sense that information had been gained from having taken part in the discussions.

Ann (iv): Yes they (*the discussions*) gave you more information and just helped with the general background and stuff. Helped to make my own conclusions about it, my own opinions and stuff.

Sally (iv): Yes, it makes you concentrate more. It is easy to tune out if you are just taking notes, you don't really read what you are writing, if you have to put input into it.....You have to know more about what you are talking about.

Active participation was an inherent aspect of the small group discussions. The comments about "having to know more" indicate that some students felt they had to demonstrate their knowledge when taking part in discussions. Although this is a positive aspect for motivating students to find out information and that more information/ ideas were gained as a result of sharing, it may also be inhibitory for any students who did not feel confident about their knowledge.

Independent research

Students were provided with background research materials from the cancer society, texts and scientific journals. They were given approximately six lessons for this. Five students used the time effectively whereas others talked or did not organise their time efficiently for researching. The independent learning aspects of the unit were important for students in terms of gaining researching skills, monitoring and evaluating their learning.

The teacher's comments indicated that he knew some students preferred to be told the information, because it is the approach they are accustomed to using. He also showed some empathy with the idea of giving them notes himself.

Teacher (iv): Then the background information I gave them, some of it was me getting them to take notes, but I did provide some notes. They liked that, mainly because it is what they are used to I think, at school. Especially the ones like Marianne who are very efficient in their working, they don't like to be mucking around having to find stuff. If I already know, they want me just to tell them, and they remember it. They don't want to waste time. "To hell with discovery, just tell me".

Despite his acknowledgment of what students would prefer, he wanted the students to take more responsibility for their own learning. He considered that the approach taken this year allowed this to happen.

Teacher (iv): There was greater individual responsibility taken for the work this year. They weren't just sitting there waiting to be spoon fed. It was a lot clearer this year that what they had to go and find out and that it was up to them to do it. No one was going to do it for them.

Other more detailed perceptions of the strategies used to make researching and essay writing skills explicit are reported elsewhere (Conner, 2000).

Planning, monitoring and evaluative approaches

Thinking journals with prompters on bookmarks were used to promote and enhance metacognition. Most of the entries were in the form of lists of information students needed to find out, which showed monitoring of learning and some planning. Other entries were questions that they were wondering about or simply just statements about what had surprised them or that they had found interesting.

Researcher: Did you find it useful for you though? Is it (*using a* journal) a useful thing to do?

Charlie (iv): Yes because I found out questions. It made me think about the things because it had all the things to think about questions (*prompters*) and it made me think about cancer more as a whole and I wanted to find out more information and I found out more information.

Mary (iv): The journal did (*help)* too even though I didn't do it that much but it helped you to know what you don't know and what you do know.

Researcher: So how did that help?

Mary (iv): What you didn't know you read up on or found out information, because I (*usually*) didn't really pay much attention because I didn't know, I'll find out that later when it comes to the test but it helped me learn it beforehand instead of waiting to the last minute.

Researcher: Did it help you kind of identify what you knew? Were the prompters useful, those little bookmarks you had?

Mary: Yes, it was like a guide so it did help.

Students' perceptions of the purpose of the journal influenced how they used them. Several students considered that the journal was for their own monitoring.

Samantha (iv): It was for me and then it was for you. To help me get into writing things down and working out what I needed to know, but it was also for you, to see where we were up to.

Niome (iv): It was for me. It gives you a greater depth of understanding. More of a focus on what we're doing. When you've written down what you think, you're more likely to focus on it.

Two students did not write in their journals at all. Several students thought that the journal was unimportant or found it time consuming to write entries. However an examination of journal entries of one of these students revealed that she had 6 separate entries which was more than the average 5 and wrote 14 questions (average 3.5 per student). Some questions she wrote were quite personally relevant eg.

Liz (j): What cancers are most common in teenagers? How much does our childhood health determine our future health eg. sun exposure - skin cancer? What else can have dangerous effects? How can hot drinks, fats and alcohol lead to some cancers? Can you get cancer anywhere or just anywhere you have fat or muscle or blood?

Despite the reticence of some students to use their journals, the teacher considered that using the journals helped the students to focus on what they needed to do.

Teacher (iv): The journal writing, some were keen to do that, I think that they got keener as they progressed, they could see the value of it, but initially they couldn't quite see the point of it apart from using it as a diary just to remind them what they have to do. They were actually talking

to themselves, they had never done that in a material way before. I think the kids don't spend near enough time looking at their own performance for a period or for a section of time. The journals forced them to do that. So the journals, I think were a good idea but certainly the prompting questions needed to be there because they didn't know how to start to talk to themselves on paper unless they had some specific things to look at.

The teacher was asked if the improvement in the essays this year was due to making the inquiry and essay writing procedures more explicit.

Teacher (iv): I think it was partly that, possibly, but certainly because the log books, they had actually written down there what they were short in, so that they knew what they had to go away and bone up on.

Interviewer: So is it monitoring of "what I need to know"?

Teacher : Yes. Well just the way they were using the resources, you could see them searching for specific bits of data that they needed and that was from their log, (*they were thinking or writing*) "I need to know some facts and figures on this", so they would then go to the book and find that. So that was working. In previous years I have had huge troubles with kids wanting to take those books away and nobody has asked to do that this year.

The teacher has, of course, made the assumption that the reason the students did not want to take the resources home was their efficient use of them. Classroom observations indicated that this was probably true for 10 of the 16 students in the study group. The number of entries in journals (average 5.2), as determined by dates or slightly different writing style/ colours over the 4 1/2 weeks of the unit, suggest that the journals were not used to the extent that the teacher believed they were. However, because journals had never been used by these students before in their 12 years of schooling, any monitoring of learning or thinking about the social and ethical issues by writing in their journals was considered to be a bonus.

Peer check

Those students who completed essays swapped with another student and used a marking schedule which was negotiated between the teacher and the students. The same marking schedule was used by the teacher to evaluate the essays. Most of these students thought the peer check was very useful and appreciated the feedback they got from their peers and what they learned from reading someone else's essay.

Lois (iv): That worked when you got other people to check it, that worked because Terri checked mine and then she wrote down a whole list of other stuff I could do, like I didn't have any defined causes or something for my essay and she gave me a whole checklist of what I can do.

Charlie (iv): Yes, I think it did just to see because she had different ideas to mine and I think it was good to read someone else's and our teacher gave us an essay, half an essay and I got 33 out of 40 and I read through that and that was actually a lot of help, **it has got to be the thing that helped me most**, just to see someone else's essay, what they did and they got quite high marks.

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Mostly it was beneficial to the reader/marker as it gave them ideas and insights into what could be written and how it could be organised, or they learned from negative examples. However, some students were too afraid to put their peers down by giving negative feedback. There was also uncertainty as to how to allocate the marks because some students felt that they did not have the appropriate background to know what could be included as either information or examples.

> Mitchel (iv): I think it was good to read other people's essays to get ideas and think what you have missed out and that sort of thing, but I really think that writing comments and giving them marks wasn't very good because at that stage half of us didn't know what was right and wrong anyway because we hadn't had the marks and so you couldn't say that's wrong because you don't even know that. But also it's not fair to tell someone they have got a low mark or something like that. You have to give your friend a high mark otherwise they are going to be mean.

The teacher considered that the peer check was very worthwhile.

> Teacher (iv): The peer check I think, was well received. They probably take more notice of their peers than they do of us. I wouldn't be surprised.

Limitations and the significance of the approach for future practice

The aim of using this approach was to promote students' awareness of and communication about the social and ethical issues surrounding cancer more directly. The findings clearly show that most students broadened their ideas about social and ethical issues linked with cancer. Evidence to show how the unit influenced their communication of the issues is less clear. This report is limited to results of questionnaires, students' self-reports and the teacher's impressions. An analysis of specific interactions during small group discussions could have been useful. It was difficult to analyse group discussions as they occurred because of background noise resulting from five groups working simultaneously. The written communication of the social and ethical issues in essays is also linked to students' skills for essay writing, particularly planning and monitoring (Conner, 2000).

In this unit there was a strong emphasis on the inquiry approach. Some students were not accustomed to independent study. Four of the thirteen students who completed essays commented either in interviews or in their journals that they still did not feel confident that they had enough factual information on two cancers (a requirement of the essay) to write a good essay. This aspect could be linked to these students' perceptions of what learning is in a biology classroom and what was required for the essay. It could also be linked to assumptions made by the teacher about the degree to which these students were prepared and were able to work as independent learners. Some of these students lacked motivation to efficiently use their time or they preferred an easier effort option of teacher-directed instruction.

Small group and whole class discussions on the issues of cancer treatment, ethical issues in videos, genetic screening, euthanasia and human rights provided forums for students to voice their opinions. Students stated that they had to "know more" about the content in order to discuss the issues. This is consistent with the notion that a community can be powerful for constructing meaning, especially when students must be explicit and negotiate regarding their beliefs (Bransford, *et al.*, 1999). Van Rooy (1993) has reported that group

work can challenge students and develop intellectual growth through communication, listening and organisational skills necessary for decision making in bioethics.

The discussions were successful because they were participative, represented real situations, and involved some degree of tension (moral disequilibrium). The experiences of students were placed in a context, and in many cases were personally relevant, rather than the issues of cancer being delivered in a universal framework. The key here is not what was learned, so much as how the learning took place. Emotions, context, reason and relationships were key elements in this interactional structure. The group/class discussions were a 'way in' to promote students' thinking and reflection on their ideas about the issues.

The role of the teacher in facilitating the approach was vital (Conner, 1999). The students trusted the teacher to take their ideas and questions seriously and to manage it fairly. The teacher was able to maintain his integrity in that he established mutual respect. When asked for his opinion, he gave more than one point of view to emphasise his objectivity and gave a balance of ideas. He modelled an ability to listen and discuss respectively with those who held views different from his own. This demonstrated a valuable skill to the students and is consistent with the environment considered to be conducive for discussing controversial issues (Solomon, 1991). Most students felt confident and comfortable enough to ask questions and give their own opinions. The discussions in this unit provided students with opportunities to develop respectful disagreement. In order to establish this culture, teachers need to model mutual respect. Otherwise discussions may reflect power structures or egomanical grandstanding.

One of the aims of the approach was to promote more conscious control of learning processes. Journal writing was difficult for most students, likely because it was unfamiliar to them and they did not see the purpose of the journal in terms of their learning. Two students did not use their journals at all. Most students needed prompting and used the statements provided on bookmarks to help them. The time taken to write in journals was considered by some students to be a disadvantage. This has also been reported elsewhere (eg. Boud *et al.* 1985).The lists and questions they wrote showed that students used the journals for some planning and monitoring of progress, clarifying ideas and showing openness to new ideas, meeting an aim of the approach. The teacher thought that the students were more focussed on finding the information they needed as a result of using their journals.

Causing the students to plan, monitor and evaluate their own learning may have been sufficient alone to produce positive self-reflective and self-directed effects for some students. More emphasis on planning and monitoring for researching and essay writing with stricter deadlines for completion of written plans would have helped some students. Journal writing could be used with inquiry approaches in schooling prior to year 13. This would allow students to become more familiar with planning and monitoring their own learning.

The study's positive results are also likely to be due to the effects of the highly supportive learning environment in which the students operated, an environment which assisted some students to develop and successfully use, their self-directed learning abilities. The role of the teacher in creating this environment was vital. The relationship between the teacher and the students was open and facilitative. His insistence on an independent mode of learning during the research phase and encouragement of reflective questioning was crucial to the approach.

References

Barman, C. R., & Hendrix, J. R. (1983). Exploring bioethical issues: an instructional model. *The American Biology Teacher, 45*(1), 23-31.

Boud, D., Keogh, R. & Walker, D. (1985). *Reflection: Turning Experience into Learning*. London: Kogan Page.

Bransford, J., Brown, A. & Cocking, R. (1999). *How People Learn: Brain, Mind, experience, and School.* Washington: National Academy Press.

Carr, M., Barker, M., Bell, B. Biddulph, F. Jones, A., Kirkwood, V., Pearson, J. and Symington, D. (1994). The Constructivist Paradigm and Some Implications for Science Content and Pedagogy. In P. Fensham, R. Gunstone & R. White (Ed.), *The Content of Science.* London: The Falmer Press.

Cohen, E. G. (1994). Restructuring the classroom: Conditions for productive small groups. *Review of Educational Research, 64,* 1-35.

Conner, L. (*in press*). The inclusion of social issues in the Science and Technology Curriculums in N. Z. and the implications for teaching. *Pacific Asian Education* 12(1) *forthcoming*..

Conner, L. (1999). Investigating Cancer Issues: A year 13 project. *Paper presented at the 30th annual conference of A.S.E.R.A.* Rotorua, New Zealand. 8 - 11 July, 1999.

Conner, L. (2000). Inquiry, discourse and metacognition: Promoting students' learning in a bioethical context. *Paper presented at the 2000 NARST Annual Meeting,* New Orleans, LA. April 28-May 1, 2000.

Dawson, V. and Taylor, P. (1999). Teaching Bioethics in science: Does it make a difference? *Australian Science Teachers' Journal,* 45(1), 59-64.

Garrison, D. R. (1992). Critical thinking and self-directed learning in adult education: An analysis of responsibility and control issues. *Adult Education Quarterly,* 42(3), 136-148.

Geddis, A. (1991). Improving the Quality of Science Classroom Discourses in the Science Classroom: Reflecting on Initial Difficulties. *Research in Science Education,* 28(3), 317-336.

Gold, R. L. (1958). Roles in sociological field observations. *Social Forces,* 36, 217-223.

Guba, E. G. & Lincoln, Y. S. (1989). *Fourth generation evaluation.* Newbury Park, CA.:SAGE

Gunstone, R. F. (1994). The Importance of Specific Science Content in the Enhancement of Metacognition. In P. Fensham, Gunstone, R., and White, R. (Ed.), *The Content of Science: A constructivist Approach to its Teaching and Learning* (pp. 131-146). London: The Falmer Press.

Lipman, M. (1987). Ethical Reasoning and the craft of Moral practice. *Journal of Moral Education,* 16(2), 139-147.

Merriam, S. B. (1988). *Case Study Research in Education A Qualitative Approach.* San Francisco: Jossey- Bass.

Ministry of Education. (1993a). *Education for the 21st Century.* Wellington. Learning Media.

Ministry of Education. (1993b). New Zealand Curriculum Framework. Wellington: Learning Media.

Ministry of Education. (1994). *Biology in the New Zealand Curriculum.* Wellington. Learning Media.

Paris, S. G. & Winograd, P. (1990). How metacognition can promote academic learning and instruction. In B. F. Jones & L. Idol (Eds.), *Dimensions of thinking and cognitive instruction* (pp. 15-51). Hillsdale, NJ: Lawrence Erlbaum Associates.

Rudduck, J. (1986). A strategy for handling controversial issues in the secondary school. In J. J. Wellington (Ed.), *Controversial issues in the curriculum* (pp. 6 - 18). Oxford: Basil Blackwell.

Ryan, R. and Stiller, J. (1991). The Social Context of Internalisation: Parent Teacher Influences on Autonomy, Motivation and Learning. *Advances in Motivation and Achievement,* 7, 115-149.

Sharp, A. M. (1987). What is a community of Inquiry? *Journal of Moral Education,* 16 (1), 37-45.

Solomon, J. (1991). Group discussions in the classroom. *School Science Review,* 72 (261), 29-34.

Van Rooy, W. (1993). Teaching Controversial Issues In The Secondary School Science Classroom. *Research in Science Education,* 23, 317-326.

Winne, P. (1996). A metacognitive view of individual differences in self-regulated learning. *Learning and Individual Differences,* 8(4), 327-353.